

TERMINAL LEARNING OBJECTIVE

ACTION

Troubleshoot comparator, binary decoder and decimal encoder circuits.

CONDITION

Given a classroom environment, Computer Aided Instruction (CAI) workstation, NIDA 130 Electronic Trainer, Digital Multimeter w/test leads, Digital Logic Probe, PC130-108, PC130-109, PC130-110 and official OMEMS reference material.

STANDARD

Correctly answer 18 of 25 questions concerning comparator, binary decoder, and decimal encoder circuits.

CLASSIFICATION: UNCLASSIFIED

SAFETY CONSIDERATIONS: ELECTRICAL SHOCK HAZARD
ELECTROSTATIC DISCHARGE

ENVIRONMENTAL: NONE

RISK ASSESMENT: LOW

ACTION

Describe the purpose and operation of combinational logic circuits and universal NAND gates.

CONDITION

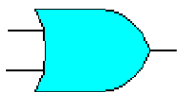
Given a classroom environment, Computer Aided Instruction (CAI) workstation, NIDA 130 Electronic Trainer, Digital Multimeter w/test leads, Digital Logic Probe, PC130-108, PC130-109, PC130-110 and official OMEMS reference material.

STANDARD

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AND



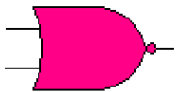
OR



XOR



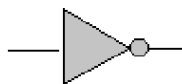
NAND



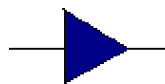
NOR



XNOR

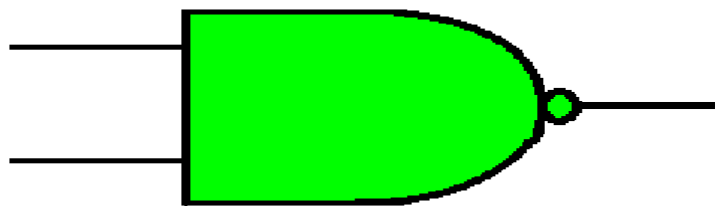


INVERTER

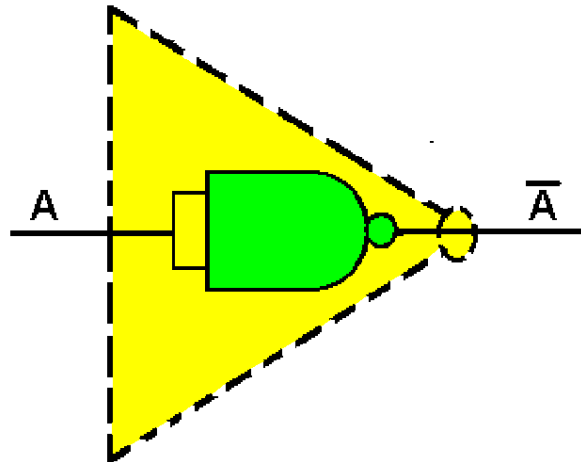


BUFFER

Integrated Circuit Logic Gates



UNIVERSAL LOGIC GATE
NAND GATE

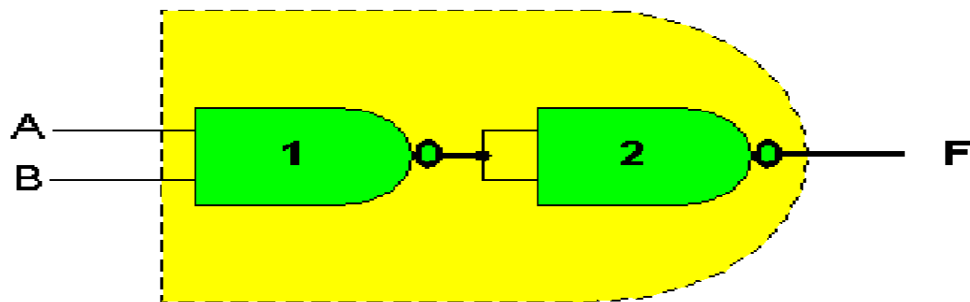


INVERTER FUNCTION USING NAND GATE

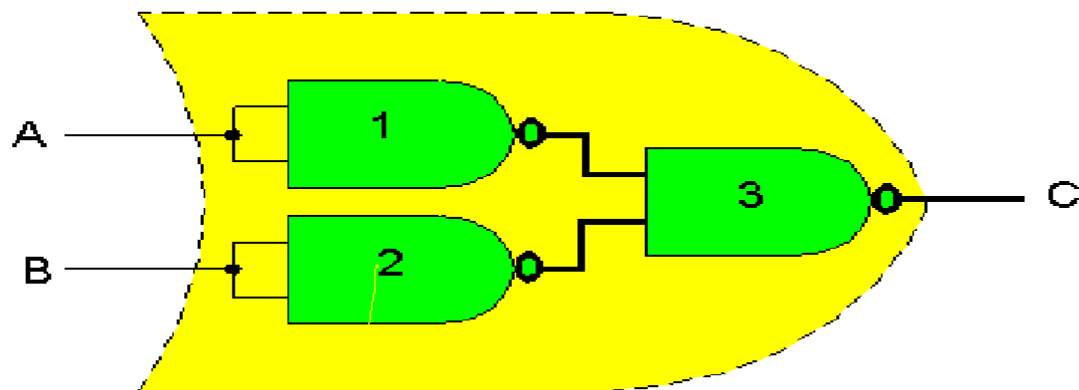


<i>Input</i>	<i>Input</i>	<i>Output</i>
<i>L</i>	<i>L</i>	
<i>L</i>	<i>H</i>	
<i>H</i>	<i>L</i>	
<i>H</i>	<i>H</i>	

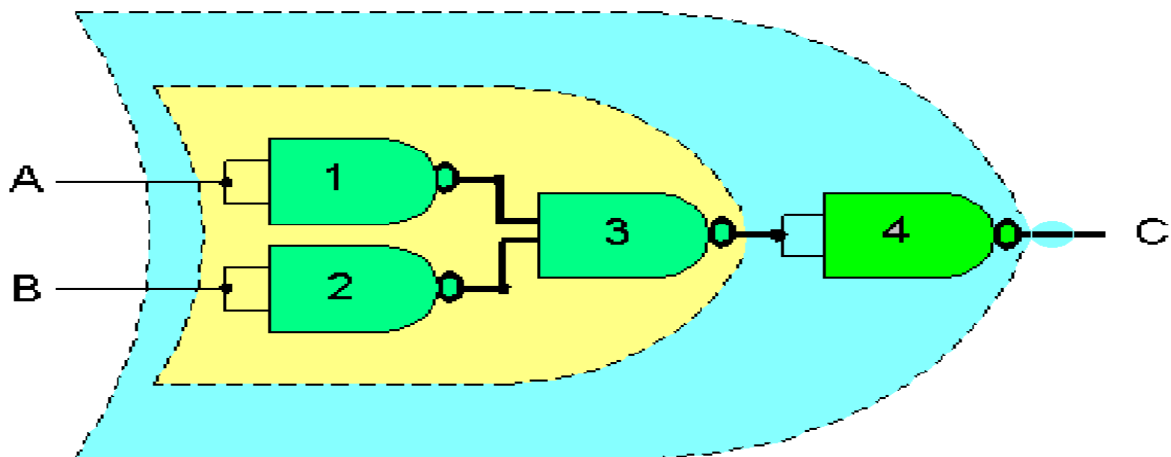
Two input NAND gate logic level



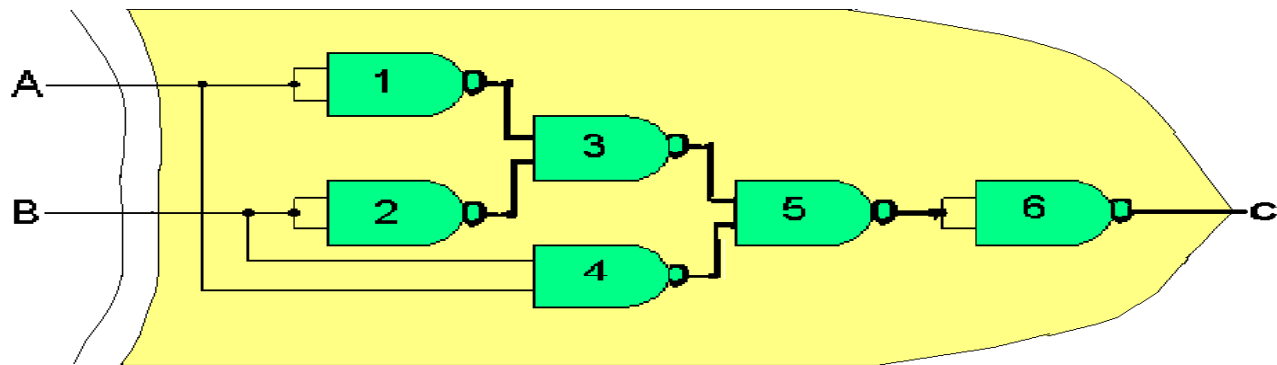
AND Function Using NAND Gates



OR Function Using NAND Gates



NOR Function Using NAND Gates



XOR Function Using NAND Gates

Combinational logic is

- 1. The AND function.**
- 2. Two high inputs and a low output.**
- 3. The combination of analog and digital.**
- 4. The combining of two or more gates.**

The final output from a combinational circuit

1. Is always high.
2. Is low when the input is low.
3. Depends on the inputs and circuit function.
4. All the above

A quad NAND IC contains

- 1. 3 NAND gates.**
- 2. 4 NOR gates.**
- 3. 4 NAND gates.**
- 4. 2 NAND and 2 NOR gates.**

Which logic gate is called the universal gate?

1. AND
2. OR
3. NAND
4. XOR

ENABLING LEARNING OBJECTIVE 2

ACTION

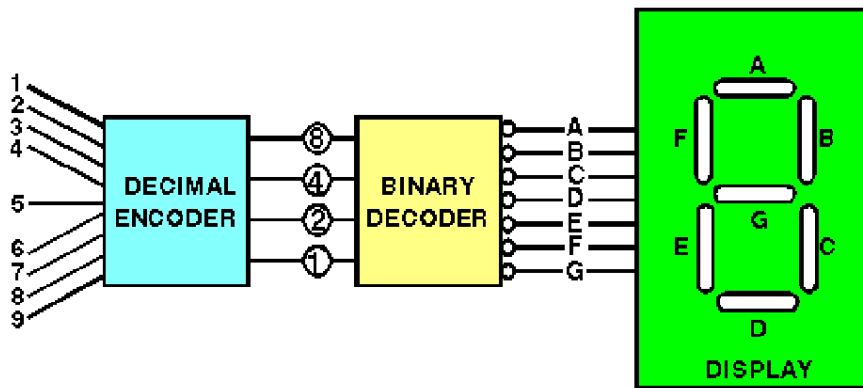
Describe the operation of decimal encoders and binary decoders.

CONDITION

Given a classroom environment, Computer Aided Instruction (CAI) workstation, NIDA 130 Electronic Trainer, Digital Multimeter w/test leads, Digital Logic Probe, PC130-108, PC130-109, PC130-110 and official OMEMS reference material.

STANDARD

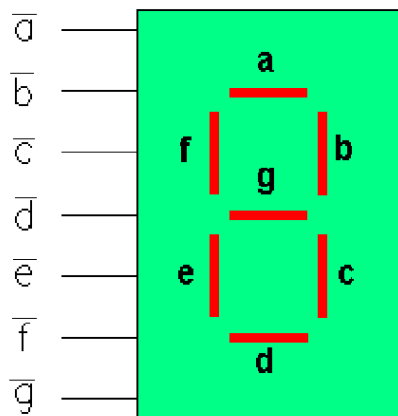
Correctly answer 18 of 25 questions concerning comparator, binary decoder, and decimal encoder circuits.



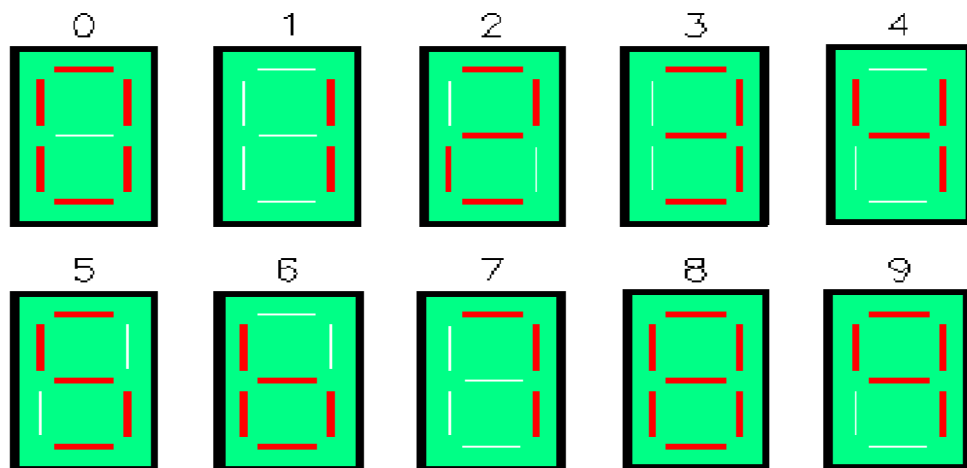
ENCODER AND DECODER CONVERSION CIRCUITS

BCD NUMBER	DECIMAL NUMBER
0000	0
0001	1
0010	2
0011	3
0100	4
0101	5
0110	6
0111	7
1000	8
1001	9

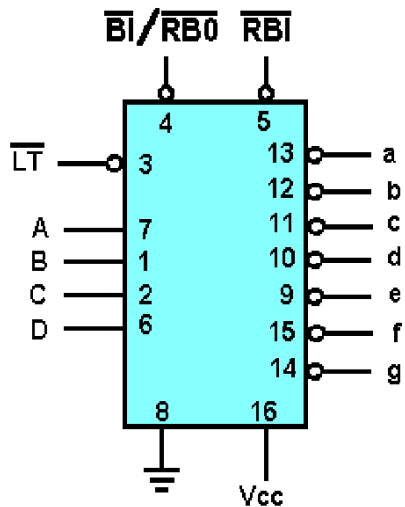
DECIMAL ENCODER CONVERT DECIMAL NUMBERS
BY THE BINARY CODED DECIMAL SYSTEM



**Binary Decoder Seven Output
Segments**



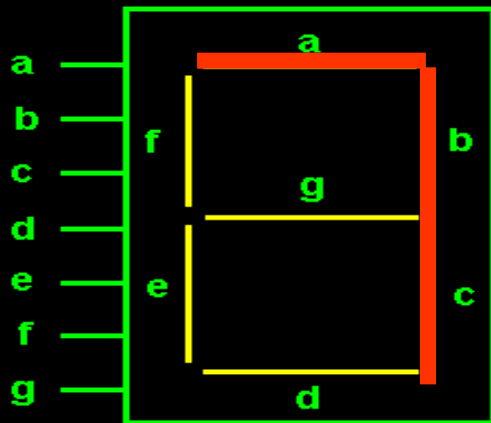
**Seven Segment Display Arranged
In The Figure Eight Pattern**



**Seven Segment Conversion
Binary Decoder**

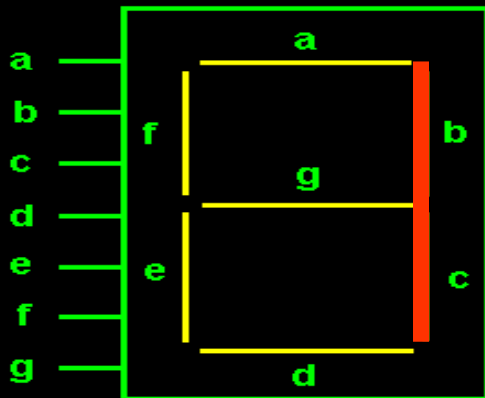
Using the figure below, what segments are forward biased when the decimal number 7 is displayed ?

1. e, f, d
2. a, b, c
3. a, f, d
4. a, g, e



Using the figure below, what segments are forward biased to display an alphanumeric 1 or l ?

1. e, c
2. b, c
3. a, g
4. g, d



4-300-13

A seven segment display uses

- 1. Eight LEDs arranged in a figure 8 pattern.**
- 2. Eight LEDs arranged in a figure 7 pattern.**
- 3. Seven LEDs arranged in a figure 8 pattern.**
- 4. Seven LEDs arranged in a figure 7 pattern.**

ENABLING LEARNING OBJECTIVE 3

ACTION

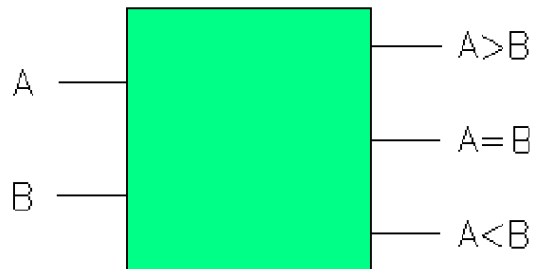
Describe the operation of comparators.

CONDITION

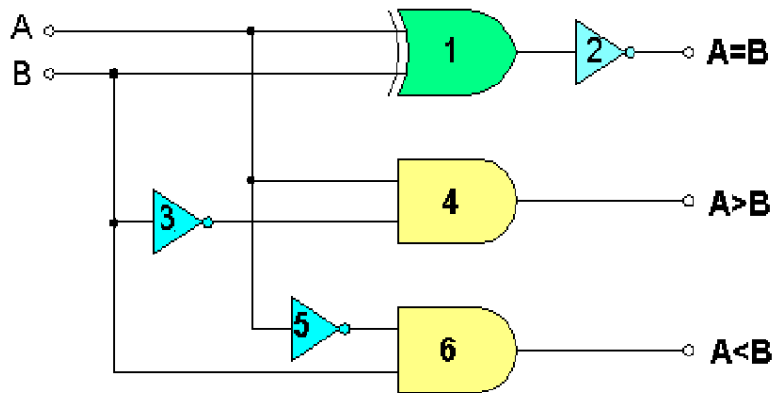
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STANDARD

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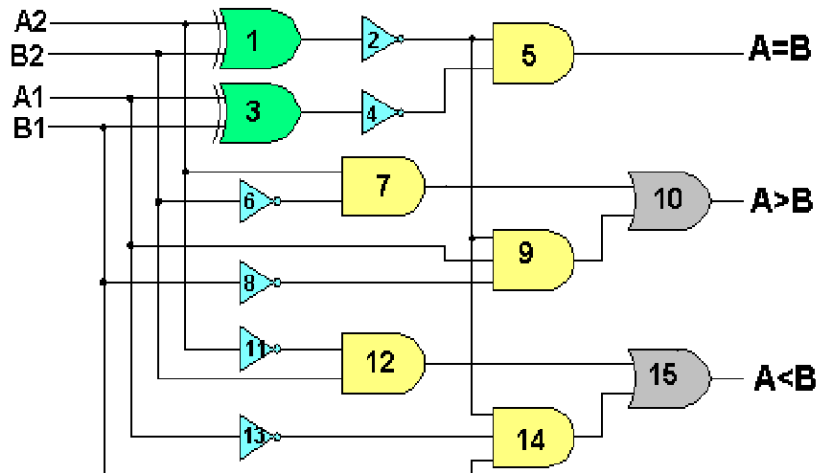
Comparison



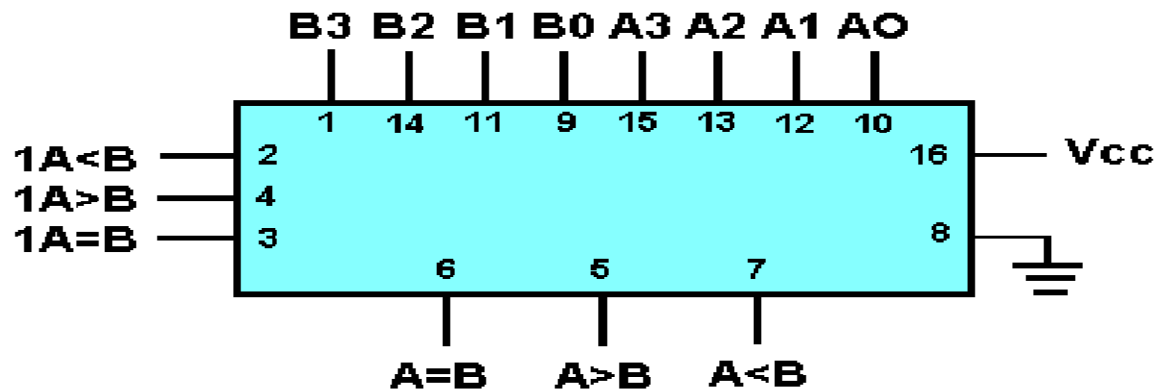
1 Bit A-B Comparator

NUMBER		COMPARISON		
A	B	$A > B$	$A = B$	$A < B$
0	0	0	1	0
1	0	1	0	0
0	1	0	0	1
1	1	0	1	0

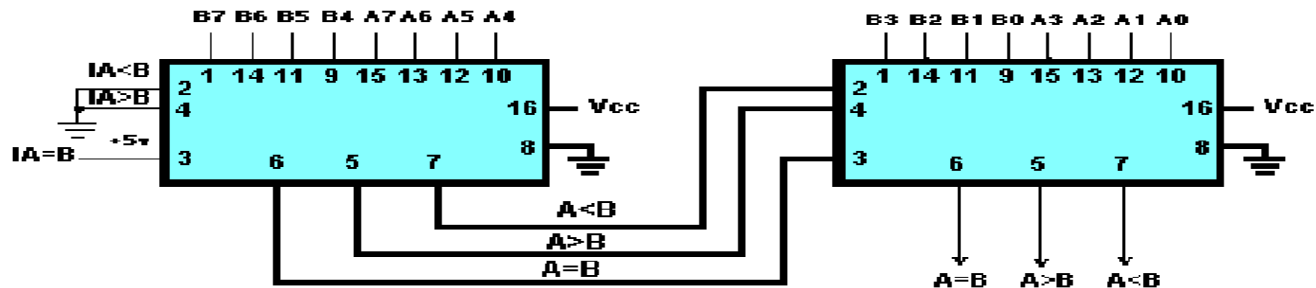
1 Bit A-B Comparator Truth Table



Two Bit A-B Comparator



7485 4 Bit A-B Comparator



Cascaded 7485s

What is the purpose of a comparator circuit ?

1. Compares two numbers to determine the product.
2. Compares two numbers to determine the sum.
3. Compares two numbers to determine if they are the same or different.
4. Compares two numbers to determine if they are added or subtracted.

What are the outputs of a magnitude comparator ?

1. $1=2$, $1>2$, $1<2$

2. $A1$, $A2$, $B1$, $B2$

3. $A=B$, $A+B$, $A-B$

4. $A=B$, $A>B$, $A<B$

If the inputs to a magnitude comparator are A (11) and B (00), what is the state of the outputs ?

1. A=B HIGH, A>B and A<B LOW
2. A=B LOW, A>B and A<B HIGH
3. A=B, A>B, A<B HIGH
4. A=B LOW, A>B HIGH, A<B LOW

ENABLING LEARNING OBJECTIVE 4

ACTION

Describe the operation of integrated circuits.

CONDITION

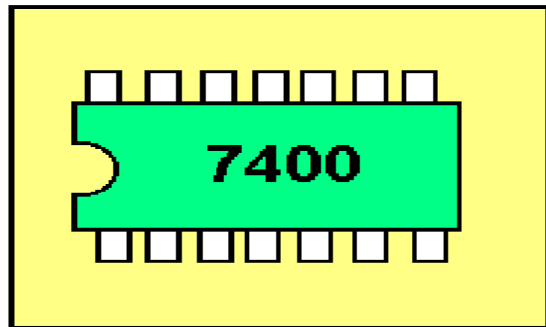
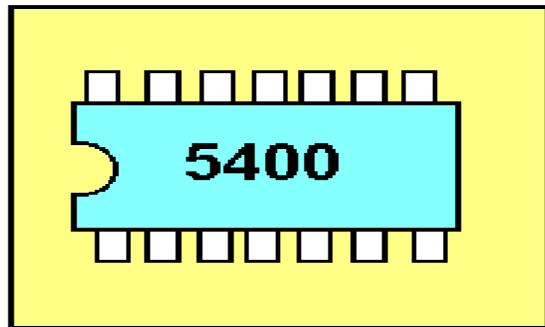
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STANDARD

Correctly answer 18 of 25 questions concerning comparator, binary decoder, and decimal encoder circuits.

FAMILY	SPEED (ns)	POWER (mw)
TRANSISTOR TRANSISTOR LOGIC (TTL)	10	10
INTEGRATED INSECTION LOGIC (IIL)	10	10
COMPLEMENTARY MOS (CMOS)	25	.00001
EMITTER-COUPLED LOGIC (ECL)	2	40

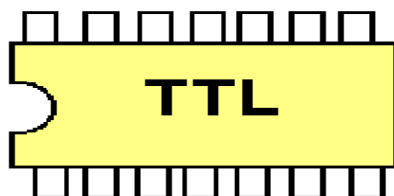
Logic Families Switching Speed & Power Requirement



TTL IC GROUPS

Input Voltage

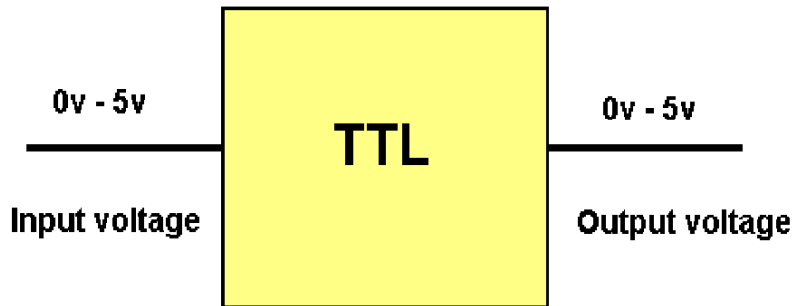
Output Voltage



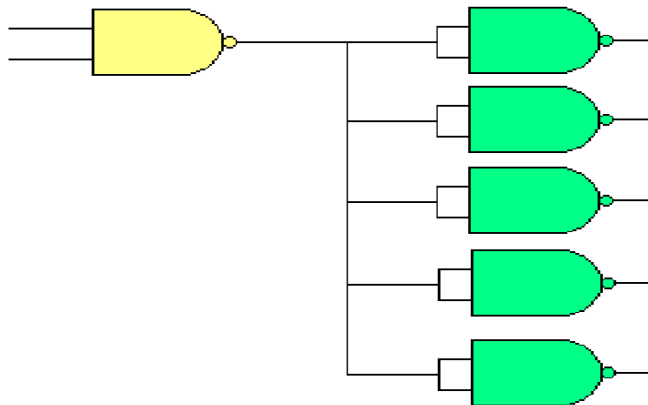
Speed

Fan-Out

TTL IC CHARACTERISTICS

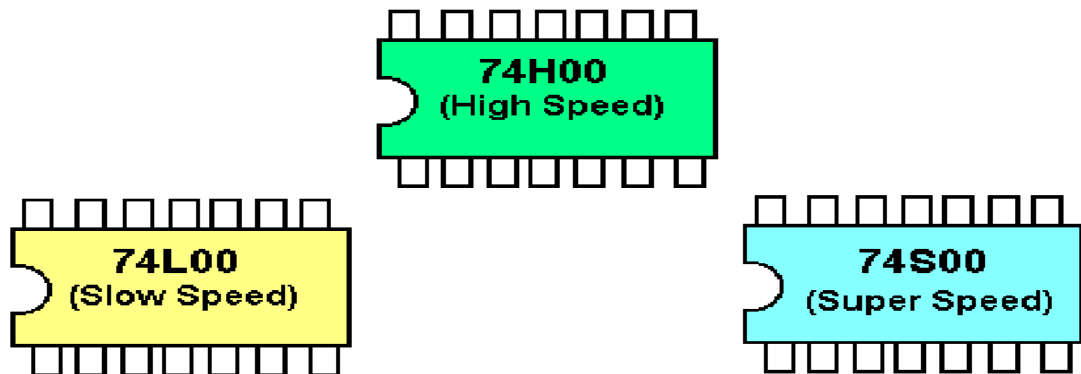


TTL IC VOLTAGE REQUIREMENTS



TTL IC Fan-Out (5)

EL09-S25



TTL IC Switching Speed Codes

Which IC has the Slowest Speed?

A. 74H20

B. 74S30

C. 74L40

D. 74K50

ENABLING LEARNING OBJECTIVE 5

ACTION

Complete CAI lessons on combination circuits, universal NAND gates, decimal encoders, binary decoders, and binary comparators.

CONDITION

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STANDARD

Correctly answer 18 of 25 questions concerning comparator, binary decoder, and decimal encoder circuits.

ENABLING LEARNING OBJECTIVE 6

ACTION

Troubleshoot comparator, binary decoder and decimal encoder circuits.

CONDITION

Given a classroom environment, Computer Aided Instruction (CAI) workstation, NIDA 130 Electronic Trainer, Digital Multimeter w/test leads, Digital Logic Probe, PC130-108, PC130-109, PC130-110 and official OMEMS reference material.

STANDARD

Correctly identify 10 of 10 malfunctions on comparator, binary decoder, and decimal encoder circuits.